UTILITY APPLICATION

BY

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FOR

UNITED STATES PATENT

ON

MULTI-LAYERED LAMINATED POSTS AND BLOCKS FOR GUARDRAIL SYSTEMS AND METHOD OF MAKING THE SAME

Docket No.: 520540.00002
Express Mail Label No.: EL988554602US

Pages of Application: 16
Sheets of Drawings: 3
Number of Claims: 27

MULTI-LAYERED LAMINATED POSTS AND BLOCKS FOR GUARDRAIL SYSTEMS AND METHOD OF MAKING THE SAME

Claim to Domestic Priority

[00001] The present non-provisional patent application claims priority to provisional application serial no. 60/422,684, entitled "Laminated Guardrail and Method for Producing the Same," filed on October 31, 2002, by Dale E. Kamarata.

Field of the Invention

[00002] The present invention relates in general to wooden posts and blocks as used for guardrail systems along roadways, and more specifically, to a multi-layered laminated post having a plurality of wood layers joined together with an adhesive for strength.

Background of the Invention

[00003] Guardrail systems are often installed adjacent to roadways and highways as a safety precaution to keep vehicles from traveling off of the road. Government safety regulations require guardrail systems to be installed in many locations where the danger posed by the vehicle traveling off of the roadway outweighs the damage that can be caused to the vehicle by hitting the guardrail system. For example, guardrail systems are installed between the road and a steep embankment or drop-off bordering the road. Guardrail systems may also be installed between the road and a body of water. Guardrail systems may be provided as a barrier between the road and a pedestrian area, e.g., walkways, bicycle paths, residential structures, and businesses. Guardrail

systems may also be provided as a barrier between opposing lanes of traffic.

[00004] Guardrail systems typically have a number of solid wooden posts embedded or implanted vertically in the ground and spaced apart from one another at regular intervals. A metal railing, typically made of steel, extends horizontally along the length of the guardrail system and is mounted to each of the vertical posts. Blocks may be mounted between each vertical post and the horizontal metal railing in order to offset or space the railing away from the post so that the vehicle's tire is not caught under the railing on impact with the guardrail system.

[00005] Guardrail systems are intended to absorb the impact of a vehicle striking the barrier. When a vehicle collides with the guardrail system, the metal railing will typically bend and the post may shift in the ground or split. However, regardless of its final condition, the guardrail system must stop the momentum of the vehicle. The guardrail system must not break or otherwise fail in any manner that would allow the vehicle to continue past the barrier. On the other hand, the vehicle should not bounce off the guardrail system and pose a danger to other traffic, pedestrians, or nearby objects. Ideally, the guardrail system should give to absorb the momentum of the vehicle and bring it to a stop, but should not allow the vehicle to break through.

[00006] The principal structure stopping the momentum of the vehicle is the wooden post implanted in the ground. Each state has established safety rules and tests, in line with Federal Highway Administration and U.S. Department of Transportation guidelines, which the post must pass to be certified for use as structural support for guardrail systems along roadways. The post

must withstand certain levels of impact from a test mass without snapping or otherwise allowing the test mass to continue past the test point. To date, most guardrail posts that are capable of receiving government certification are manufactured from solid lumber, e.g., No. 1 Grade Southern Yellow Pine, with nominal dimensions of about 6x8x90 inches. The No. 1 grading dictates that the wood must adhere to standard visual grading rules for solid lumber, and are usually taken from the choice lumber of large trees.

[00007] Large trees are a scarce natural resource and should be used judiciously. With increasing miles of new highways and the need to replace aging and damaged posts, the high demand has caused availability problems and driven up the cost of using certified solid lumber guardrail posts. There are insufficient natural resources to supply the demand for certified guardrail posts using No. 1 grade solid lumber.

[00008] A need exists for a guardrail post that meets the government safety regulations and passes the testing criteria but that does not require the use of solid lumber.

Summary of the Invention

[00009] In one embodiment, the present invention is a guardrail post comprising a plurality of wood layers and an adhesive joining the plurality of wood layers.

[00010] In another embodiment, the present invention is a method of making a wood post for use in guardrails comprising the steps of providing a first wood layer, providing a second wood layer, and joining the first and second wood layers with an adhesive.

Brief Description of the Drawings

[00011] FIG. 1 illustrates a front-view of a guardrail system with vertical post and horizontal railing;

FIG. 2 illustrates a side-view of the guardrail system with offset blocks;

FIG. 3 illustrates the post made with a plurality of laminated wood layers;

FIG. 4 illustrates the post made with short lengths of wood layers;

FIG. 5 illustrates nominal or actual size 2"x2" lumber edge glued to make a nominal or actual size 2"x6" plank; and

FIG. 6 illustrates a top view of the post with angled corners.

Detailed Description of the Drawings

[00012] Referring to FIG. 1, a front-view of guardrail system 10 is shown with a number of posts 12 for embedding or implanting vertically in the ground and spaced apart from one another at regular intervals. A side view of guardrail system 10 in FIG. 2 illustrates offset block 14. A metal railing 16 made with steel extends along the length of guardrail system 10 as shown in FIG. 1. Metal railing 16 is bolted or mounted through offset blocks 14 and through post 12 with bolts 18 to create spacing between railing 16 and post 12. Alternatively, offset block 14 is glued to post 12 and railing 16 is bolted or screwed to offset block 14.

[00013] Guardrail system 10 is installed along roadways and highways as a safety precaution to keep vehicles from traveling off of the road. Guardrail system 10 can be installed along steep embankments, drop-offs, bodies of

water, pedestrian areas, and between opposing lanes of traffic. In other applications, guardrail system 10 can be installed alongside bridges, tunnels, overpasses, racetracks, bike paths, railways for trains, airport taxiways for aircraft, amusement park rides, water routes, and other locations where it may be necessary to restrain a vehicle, craft, or object that is out of control or has left its normal operating boundaries.

[00014] To install guardrail system 10, a series of holes are dug, drilled, or otherwise formed in the ground each about 18-24 inches in diameter and about five feet deep. Posts 12 are placed in the holes and the holes are then back-filled and compacted using a pneumatic tamper. Water may be added to increase the moisture content of the soil in and around the post as necessary to achieve a compaction density of about 95%. A hole is drilled horizontally through a top portion of posts 12. Offset blocks 14 and metal railings 16 are bolted to posts 12 using bolts 18.

[00015] Guardrail system 10 absorbs the impact of a vehicle striking the barrier. Depending on the crash dynamics, the vehicle may strike guardrail system 10 in many different orientations. The front of the vehicle may strike first, or the back of the vehicle may hit first, e.g., during a spin. Guardrail system 10 is designed with sufficient strength and dynamics to turn or deflect the vehicle so that it becomes oriented or aligned substantially parallel to the guardrail system. In other crash scenarios, the vehicle may have flipped, or be oriented on its side, such that the top or bottom of the vehicle strikes first. In any crash event, metal railing 16 will typically bend or flex and post 12 may shift in the ground or split upon impact. However, posts 12 have sufficient strength so that they will not break

or snap on impact. Accordingly, guardrail system 10 is designed to give on impact in order to stop the momentum of the vehicle and keep it from leaving the roadway. Guardrail system 10 should not break or fail in any manner that would allow the vehicle to continue past the barrier.

[00016] The principal structure stopping the momentum of the vehicle is post 12 implanted in the ground. Each state has established safety rules and tests, in line with Federal Highway Administration and U.S. Department of Transportation guidelines, which post 12 must pass to be certified for use as structural support for guardrail systems. Post 12 must withstand certain standardized levels of impact from a test mass without snapping or otherwise allowing the test mass to continue past the test point. In one impact test, a weight is suspended by a tether and raised radially along its full extended arc to a predetermined height. The weight is released and strikes post 12 at the bottom of its swing arc. Another impact test involves a full-scale crash test, wherein different size and weight vehicles are driven into guardrail system 10 as supported by posts 12. In all impact tests, various sensors and/or visual inspection are used to determine the performance of guardrail system 10 and/or post 12. Measurements and visual inspection are made before, during, and after the impact. Post 12, made using the manufacturing process described below, passes the safety rules and impact tests of most, if not all, states.

[00017] Turning to FIG. 3, a portion of post 12 is shown comprising a plurality of layers or planks of wood, engineered wood products, or man-made products. Post 12 has at least two layers, glued or laminated together with adhesive or bonding agent. In some embodiments, posts 12

are made with between 4 and 6 laminated layers, although more layers or fewer layers can be used depending on the desired strength, type of materials, and projected costs.

[00018] In the present discussion, post 12 uses four wood layers 20, 22, 24, and 26 each cut to 2x6x270 inches nominal. Layers 20-26 may be various species of wood, including Pine, Oak, and Douglas Fir. Wood layers 20-26 are kiln dried or air dried to adjust the moisture content to the desired level. The moisture content tends to remain relatively constant during the lamination process. Alternatively, the finished post may be dried after assembly. Wooden layers 20-26 are pressure-treated with copper chromate arsenic (CCA) for environmental protection, moisture barrier, and to repel insects. The wooden layers are placed in a pressurized autoclave chamber or cylinder, which forces the CCA into the pores of the wood. Pressure treatment may be performed after lamination of the wood layers.

[00019] Once pressure-treated, wooden layers 20-26 are laminated or glued together. A glue laminate, bonding agent, or adhesive, for example, a two-part mixture containing CX-47 and Isoset 320 from Ashland Chemical, is selected to join or laminate wood layers 20-26. The adhesive components are mixed together just before application to the wood faces. The adhesive is spread at a rate of about 90 lbs. per 1000 square feet. In one embodiment, the adhesive is applied to opposing faces of layers 20 and 22. Layer 20 is held securely to layer 22 and allowed to cure for 48 hours. The adhesive is applied to opposing faces of layer 24 and the joined combination of layers 20-22. Layer 24 is then held securely to layers 20-22 and allowed to cure. The adhesive is applied to opposing faces of layer 26 and the joined combination of layers 20-24. Layer 26 is then

held securely to layers 20-24 and allowed to cure. A clamp can be used to hold the layers together during the curing process.

[00020] In another embodiment, the adhesive is applied to opposing faces of all layers 20-26 at once. All layers 20-26 are held together securely with the clamp and allowed to cure for 48 hours. The laminated layers may be heated to enhance the bond and/or to decrease the time it takes for the adhesive to cure.

[00021] Wood layers 20-26 are purchased as rough cut from saw mills in 2x6 inch full dimensional sizes. With the added strength provided by the laminated layers, lower grades of wood can be used for posts 12. The wood is planed or shaved, e.g., 1/8 inch, to smooth the faces which will be glued together. The planed surface serves to open the pores of the wood and allows for stronger adhesion when the glue is applied. The final laminated layers 20-26 are further planed to smooth the remaining rough surfaces. The resulting laminated layers 20-26 is a wood structure with a nominal size of about 6x8x270 inches. The laminated layers 20-26 are cut into three equal lengths for posts 12. Alternatively, the wood layers can be pre-cut to the desired length for posts 12 before the lamination process.

[00022] Post 12 is marked with layer 20 as the inside layer, i.e., on the railing side facing the roadway. Layer 26 may be marked as the outside layer, i.e., opposite side from the railing facing away from the roadway. Post 12 is positioned in the ground with the laminates running parallel to the roadway. The direction of the grain for laminated layers 20, 24, and 26 faces or cups toward the outside of post 12. The direction of the grain for laminated layer 22 faces or cups toward the inside of post 12.

[00023] In general, stronger woods, such as Oak and Southern Yellow Pine, are used for layer 20. More pliable woods, such as Ponderosa Pine, Spruce, Spruce Pine Fir, Hemlock Fir, and other western woods, are used for layer 26. The stronger inside wood layer stands up better to the impact of the collision. The more pliable outside wood layer allows the post to give without snapping or breaking on impact. In other embodiments, one species of wood is used for all layers. The adhesive also tends to increase pliable and allow post 12 to give on impact.

[00024] Materials other than solid wood can be used for one or more layers of post 12. One example is engineered wood products. Another example is flexible and pliable man-made materials such as fiber reinforced plastic which can be used for the outside of layer 20 or layer 26 or for an internal layer. It could also be used to adhere to the sides of the post, taking into account several or all of the layers. The plastics should adhere to the adjacent wood layers. A liquid polymer can be disposed between layers for additional pliability or on the sides of some or all of the layers or outside of layers 20 and 26. A metal plate or grate can be used for an internal or external layer. Other reinforcements may include rods, dowels, and rebar.

[00025] In many cases, the 2x6 inch wood layers or planks comes in lengths less than 270 inches. The shorter length wood sections are often more available, lower cost, and a better use of natural resources. In FIG. 4, wood layer 30 is made with two or more planks laid end-to-end in order to reach the necessary 270 inches in length. Likewise, wood layers 32, 34, and 36 are each made with two or more planks laid end-to-end to reach 270 inches in length. The shorter planks are

joined lengthwise with finger joints 38 glued together with the same adhesive used for the wood faces or a different adhesive than used on the faces. Finger joints 38 form interlocking connections and are offset or staggered between adjacent layers for additional strength. Other types of joints such as scarf joints can also be used.

[00026] In other embodiments, the 2x2 inch wood boards are substituted for one or more of the 2x6 wood planks. In FIG. 5, boards 50, 52, and 54 are each 2x2 inch wood sections. Boards 50-54 are edge-glued together to make one 2x6 wood plank 56. Post 12 can be made by mixing and matching different combinations and sizes of wood pieces. Post 12 may contain (1) full-size 2x6x270 inch wood planks, and/or (2) 2x6 wood planks which are shorter than full-length (<270 inches) and are joined with finger joints, and/or (3) even 2x2 boards which are shorter than full-length (<270 inches) and are edge joined to make 2x6 planks. The glue laminate gives post 12 strength even with a variety of wood sizes. Posts 12 can make use of leftover or cull lumber, underutilized wood products, or lumber harvested from smaller trees.

[00027] A top view of post 12 is shown in FIG. 6. The corners 60 of post 12 are taken off to increase the strength of the post by deflecting or spreading the force of impact over a greater surface area. In addition, the edged corners may also aid in the transition of the post through the surrounding ground upon impact. The corners of post 12 can also be notched, angled, eased, cut off, or otherwise removed for additional strength.

[00028] Offset block 14 is also made from laminated layers of wood made in a process similar to that described for post 12. Alternatively, the block may comprise a solid piece of wood. The final dimensions of

block 14 are generally 6x8x14 inches. Block 14 can be made from wood not otherwise suitable for posts 12.

[00029] A person skilled in the art will recognize that changes can be made in form and detail, and equivalents may be substituted for elements of the invention without departing from the scope and spirit of the invention. The present description is therefore considered in all respects to be illustrative and not restrictive, the scope of the invention being determined by the following claims and their equivalents as supported by the above disclosure and drawings.